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FACTORS ASSOCIATED WITH VOCATIONAL INTERESTS*

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The concept of vocational interests has been widely used by applied psychologists and various expressions of these interests have been employed in the educational and vocational counseling of youths and adults. Most counseling programs now include some consideration of measured interests and all are forced to include a consideration of expressed interests and vocational choices. Further progress in the field of interests requires increased knowledge of the genetic bases of these interests and of the factors which determine them.

The purpose of this exploratory study was to provide preliminary information concerning this problem. The purpose was not to appraise the determinants of vocational interests nor to take a census of the various factors influencing vocational choices, but to develop a number of hypotheses concerning these problems and to suggest methods of testing these hypotheses.

The problem may be concisely stated: What factors in an individual's background are related to his measured vocational interests and to his occupational choice.

SUBJECTS AND PROCEDURES

The group studied consisted of one hundred thirty-six men who came to the Testing Bureau of the University of Minnesota as pre-college cases in the spring and summer of 1940. A previously reported investigation revealed that students coming to the Testing Bureau that year were typical of University students

* These data are taken from *Factors Related to Vocational Interests*, by Ralph F. Berdie, a Ph.D. thesis on file at the University of Minnesota Library. Professor D. G. Paterson was the author's major advisor.

on the basis of high-school grades and scores on the American Council Examination and Coöperative English Test.[4] When the means of the experimental group of one hundred thirty-six were compared to the means of the total male freshmen class of the University for these three variables, the critical ratios were, respectively, .53, .10, and .73. In terms of level of ability and achievement, the group studied was not different from the total group of freshmen men entering the University.

The total group of one hundred thirty-six students was divided into six pairs of groups, each pair of groups containing all one hundred thirty-six people. These groups were:

(1*a*) All those with a primary or secondary interest pattern in the engineering group of the Strong test.* $N = 42$

(1*b*) All those without a primary or secondary pattern in the engineering group. $N = 94$

(2*a*) All those with a primary or secondary pattern in the business detail or the business contact group or both. $N = 92$

(2*b*) All those with no primary or secondary pattern in the business groups. $N = 44$

(3*a*) All those with a primary or secondary pattern in the skilled trade group of the Strong test. $N = 71$

(3*b*) All those with no primary or secondary pattern in the skilled trades group. $N = 65$

(4*a*) All those with a primary or secondary pattern in the social welfare group of the Strong test. $N = 40$

(4*b*) All those with no primary or secondary pattern in the social welfare group. $N = 96$

(5*a*) All those who have chosen engineering as their future occupation. $N = 56$

(5*b*) All those who have not chosen engineering. $N = 80$

(6*a*) All those who have chosen business as their future occupation. $N = 32$

(6*b*) All those who have not chosen business. $N = 104$

Information about these students was collected from several sources. High-school percentile ranks and scores on the American Council Examination and the Coöperative English Test were obtained from the University files. Scores on the Minnesota Personality Scale and the Strong Vocational Interest Blank were obtained from the files of the Testing Bureau. Personal information, including vocational choice, was obtained from two

* In making the pattern analyses of the Strong Interest Blank profiles, the technique described by Darley[3] was used. A student could have more than one primary or secondary pattern.

questionnaires—one which is given to all students coming to the Bureau and another which was given only to students included in this investigation.

Comparisons were made within each pair of groups upon the basis of the factors under consideration. Analysis of the quantitative variables was done by use of both analysis of variance and critical ratios. In comparisons within the engineering and business interest groups, the variance due to measured interests and the variance attributable to expressed interests were identified.

RESULTS

Family relationships have long been recognized as basic factors in determining personality. Vocational interests are also likely to be influenced by these same factors.

Of the twenty-six people whose fathers were reported by the students to be in the skilled trades, nineteen or seventy-three per cent, had primary or secondary patterns in the skilled trades group of the Strong test. Of the one hundred ten people whose fathers were not in the skilled trades group, fifty-two, or forty-seven per cent, had a primary or secondary pattern in the skilled trades group. Only four, or fifteen per cent, of the sons of skilled tradesmen had measured interests in the social welfare group, while thirty-three per cent of the sons of other people had measured interests in these groups. Forty-two per cent of the sons of skilled tradesmen had either a primary or secondary interest pattern in the engineering group while only twenty-eight per cent of the others had.

The sons of skilled tradesmen also appear to differ from others in terms of their expressed interests. Only three, or twelve per cent, of them expressed a desire to enter business, while of the others, 29, or twenty-six per cent, desired to enter business. Fifty-four per cent of the sons of skilled laborers desire to become engineers, while only thirty-eight per cent of the others do. Of the twenty-two sons of business executives, two, or nine per cent, had measured interests in engineering, and seven, or thirty-one per cent, expressed an interest in engineering. When these figures are compared to those for the sons of skilled tradesmen, the differences are apparent. Of the twenty-two sons of business executives, fourteen, or sixty-three per cent, desired to go into

business. Of the one hundred fourteen others, only eighteen, or fifteen per cent, wanted to enter business. Many of the sons of business executives and owners are planning to enter their fathers' businesses. Nevertheless, of these twenty-two, seven, or thirty-one per cent, had both measured and expressed interests in business, while of the other one hundred fourteen, twenty, or seventeen per cent, had both kinds of interests in business.

These results suggest a close relationship between the occupations of the fathers and the expressed and measured interests of the sons. This appears most apparent in the families of skilled tradesmen having sons who are considering attending college and the families of business men, particularly business executives and owners. Both the father's occupation and the son's vocational interests are likely to be influenced by common factors, but many ways in which paternal occupation could influence filial interests can be mentioned.

The cultural level of the home is determined by the socio-economic status, the ability, and the education of the parents. These factors are, in turn, all related to the father's occupation. Friends and acquaintances of the family supply children with information and attitudes regarding occupations as well as other aspects of society. Family expectations are often determined by the level of the father's occupation, and the prestige and attraction various occupations have for sons varies with the type of home from which they come.

The students were also asked for the occupation of the mother before and after marriage. Practically all of the mothers were listed as either housewives or having no occupation after marriage. There were eighty mothers, however, who were listed as either having been in some occupation before or after marriage or both. No trends similar to that found with paternal occupations could be found here. The vocational interests of these students were not greatly influenced by the occupation of the mother before or after marriage. Women's occupations probably are not as significant determinants in their lives as are the occupations of men. The range of opportunity open to women is relatively limited and many women enter occupations not because of particular abilities or personality characteristics, but only to have something to do or to earn a living before marriage, or to help the family finances after marriage. As the occupation of

the mother is seldom important to her or to her family, we need not be surprised at the little relationship this bears to vocational interests.

Family income is related to father's occupation and determines to some extent the range and type of experiences to which the children are exposed. The only method of obtaining an estimate of the father's income in this investigation was to ask the student to check what he thought was the amount. Many students do not have the faintest idea what the income of their family is and this is, therefore, an unreliable method of measurement. It was, however, the only one available. Trends found here were similar to the trends found in considering fathers' occupations. Of the seventy-one people having measured interests in the skilled trades group on the Strong test, five, or seven per cent, came from families with reported incomes of $5000 or above, while of the sixty-five people having no measured interests in the skilled trades, eleven, or seventeen per cent, came from families with incomes this large. Of the fifty-six people having expressed interests in engineering, only one, or two per cent, came from families having incomes of $5000 or above; while of the eighty other students, fifteen, or nineteen per cent, came from families with incomes this large. Of the thirty-two people expressing an interest in business, eight, or twenty-five per cent, came from families with incomes of this size, while only eight, or eight per cent, of the one hundred four with no expressed interests in business came from families having this sized income. The results found with family income are in close agreement with those found on paternal occupation, and both are perhaps expressions of closely related phenomena.

Comparisons were made within the pairs of groups on the basis of scores on the family relations section of the Minnesota Personality Scale. "High scores usually signify friendly and healthy parent-child relations. Low scores suggest conflicts or maladjustments in parent-child relations."[3] Comparisons of means revealed no significant differences between groups. Groups with different vocational interests are not differentiated by their adjustment to the family situation.

The students were also asked to check a list of possible reasons for making their vocational choices. One of the reasons listed was "Family suggestion or tradition." The percentage of

students checking this item was fairly constant in the various interest groups and there is little to suggest that students with different interests ascribe varying amounts of importance to the influence their families have upon their vocational choices.

One of the traditional arguments in the field of interests concerns the relationship between interests and abilities. Results of this investigation indicate that only a small relationship exists between abilities and interests.

Table 1 presents the critical ratios found when making comparisons between the various groups upon the basis of scores on the American Council Examination.

TABLE 1.—MEAN SCORE, STANDARD DEVIATION, NUMBER OF CASES, AND CRITICAL RATIOS ON AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION FORM 1937, FOR VARIOUS INTEREST GROUPS

GROUP	MEAN	SD	*N*	CR
Measured interest in Engineering	84.40	21.38	42	
Measured interest not in Engineering	74.47	25.69	94	2.35
Measured interest in Business	76.43	24.87	92	
Measured interest not in Business	79.84	24.74	44	.75
Measured interest in Skilled Trades	77.24	20.53	71	
Measured interest not in Skilled Trades	77.86	28.87	65	.14
Measured interest in Social Welfare	79.25	27.71	40	
Measured interest not in Social Welfare	76.82	23.56	96	.49
Expressed interest in Engineering	78.75	23.52	56	
Expressed interest not in Engineering	76.69	25.73	80	.48
Expressed interest in Business	75.53	26.82	32	
Expressed interest not in Business	78.15	24.22	104	.49

The only significant difference is found when comparing the group having measured interests in engineering with the group having no measured interest in engineering. The critical ratio of 2.35 and the '*F*' value of 5.45 are at probability levels of .02 to .05. Students with measured interests in engineering are more likely to be of superior ability as measured by this test than students without these interests. Comparisons of the groups on the basis of high-school percentile, the best single index of college aptitude, do not substantiate these results, as none of the critical ratios are above 1.37, although in this case the group with engineering interests is slightly superior to the group without them.

The students were asked to list any outstanding special abilities they possessed (music, art, writing, etc.). Of the students with measured interests in engineering, seven, or seventeen per cent, indicated they had special abilities in this field, while only three, or three per cent, of the students without these measured interests indicated they had special abilities related to engineering. Of the one hundred thirty-six cases, seventy-one, or fifty-two per cent, indicated they had no special abilities. Of the ninety-two students with measured interests in business, forty-one, or forty-five per cent, indicated they had no special abilities, while of the forty-four without these interests, thirty, or sixty-eight per cent, indicated they had no special abilities. The special abilities possessed by the people with measured interest in business showed no tendency, however, to be related to business. Relatively more of the people with measured interest in the skilled trades had no special abilities and relatively more of the people with measured interests in social welfare had special abilities. Apparently people with skilled trades interests do not consider themselves particularly gifted while people with social welfare interests do. The results suggest that a relationship exists between the individual's concept of his own special abilities and his vocational interests.

Vocational interests are only one aspect of total personality. The scores of the Minnesota Personality Scale offered other indices of personality. The results concerning the family relationship score have already been discussed.

The questions providing the 'morale' score of this scale suggest this score is an index of the individual's social naivete, of his willingness to accept social conditions as they are. Only one pair of interest groups was differentiated by this scale. Those people expressing an interest in business had a mean morale score of 12.81; those without this interest, a mean morale score of 11.87. Analysis of variance showed this variation was significant at the five-per-cent level of probability. Whatever relationship exists between vocational interests and morale is too small to be of great practical significance or importance.

Correlational studies have shown that the relationship between interests as measured by the Strong test and social adjustment as measured by the Minnesota Personality Scale is stable but not high.[1] Results presented in Table 2 show students with meas-

ured interests in engineering and students with expressed interests in engineering obtain lower scores on the social key than do students without these interests. Students with measured interests in the skilled trades obtain lower scores than do students who do not have these interests. Students with measured interests in the social welfare fields obtain higher scores than do people without these interests. People with and without measured and expressed interests in business cannot be differentiated upon the basis of social adjustment.

Relationships between interests and emotionality are not as apparent as between interests and social adjustment. High scores on the emotionality scale of the Personality Scale are "representative of emotionally stable and self-possessed individuals. Low scores may result from anxiety states or they may be obtained by over-reactive individuals."[3] Experience with the test has shown low scores are also indicative of hypochondriosis or actual poor health.

TABLE 2.—MEAN SCORE, STANDARD DEVIATION AND NUMBER OF CASES ON FACTOR II, "SOCIAL ADJUSTMENT," OF MINNESOTA PERSONALITY SCALE FOR VARIOUS INTEREST GROUPS

GROUP	MEAN	SD	*N*	CR
Measured interest in Engineering	204.3	30.1	42	
Measured interest not in Engineering	220.3	29.8	94	2.86
Measured interest in Business	217.5	30.2	92	
Measured interest not in Business	210.9	31.6	44	1.16
Measured interest in Skilled Trades	207.5	27.2	71	
Measured interest not in Skilled Trades	223.5	32.5	65	3.06
Measured interest in Social Welfare	230.5	30.2	40	
Measured interest not in Social Welfare	209.1	28.6	96	3.75
Expressed interest in Engineering	208.9	30.7	56	
Expressed interest not in engineering	219.9	30.0	80	2.08
Expressed interest in Business	224.1	29.7	32	
Expressed interest not in Business	212.7	30.5	104	1.87

The only significantly large critical ratio was found in the social welfare group. This ratio was 3.47. Students having measured interests in the social welfare fields are more stable emotionally. A popular fallacy subscribed to by many psychologists and laymen is attacked here. Often people demonstrating an interest in social welfare work are accused of being maladjusted individ-

uals attempting to ffnd their satisfaction in helping others solve their maladjustments.

Comparisons within the pairs revealed no association between measured and expressed vocational interests and economic conservatism as measured by the Minnesota Personality Scale.

The interest blanks of the 136 students were scored on two of the non-occupation keys supplied by Strong, Masculinity-Femininity and Occupational Level. Darley has described the keys as follows:

"Masculinity-Femininity—a neutral, if awkward, definition could be phrased as follows: a continuum based on the extent to which the individual's attention is held by technical, depersonalized, manipulative, concrete activities or objects in his environment (masculinity) or by cultural, aesthetic, personalized, symbolic, appreciative activities or objects in his environment (femininity).

"Occupational Level—a quantitative statement of the eventual adult 'level of aspiration,' represents the degree to which the individual's total background has prepared him to seek prestige and discharge the social responsibilities growing out of high income, professional status, recognition, or leadership in the community; at the lower end of the scale the individual's background has prepared him for the anonymity, the mundane round of activities and the followership status of a great majority of the population."[2]

Strong has shown the relationships between Masculinity-Femininity and the occupational keys range from +.79 to −.74, and that the relationships between Occupational Level and the occupational keys range from +.63 to −.82.[5]

Table 3 presents the comparisons between the interest groups upon the basis of Masculinity-Femininity. The students with measured interests in engineering and the students with expressed interests in engineering obtain significantly higher masculinity scores than do the students without these interests. Analysis of variance shows the variance attributed to expressed interests is significant when independent of the variance associated with measured interests and *vice versa*. The mean Masculinity-Femininity score for the thirty-two students with both measured and expressed interests in engineering was 129; for students with only measured interests in engineering, 92, for students with

only expressed interests in engineering, 88, and for students with neither expressed nor measured interests in engineering, 38. Neither the expressed nor measured business interest groups are differentiated by the Masculinity-Femininity score. The group with measured interests in the skilled trades is significantly more masculine and the group with measured interests in the social welfare fields significantly less masculine.

TABLE 3.—MEAN SCORE, STANDARD DEVIATION AND NUMBER OF CASES ON MASCULINITY-FEMININITY KEY OF STRONG INTEREST BLANK FOR VARIOUS INTEREST GROUPS

GROUP	MEAN	SD	*N*	CR
Measured interest in Engineering	120.02	53.69	42	
Measured interest not in Engineering	50.61	61.19	92	6.68
Measured interest in Business	64.70	65.54	90	
Measured interest not in Business	88.05	65.79	44	1.93
Measured interest in Skilled Trades	100.23	57.83	70	
Measured interest not in Skilled Trades	41.89	61.92	64	5.62
Measured interest in Social Welfare	41.00	66.07	40	
Measured interest not in Social Welfare	85.71	62.11	94	3.65
Expressed interest in Engineering	111.60	45.41	55	
Expressed interest not in Engineering	45.05	65.24	79	6.96
Expressed interest in Business	64.94	68.71	32	
Expressed interest not in Business	74.70	65.66	102	.71

Table 4 presents the comparisons of the groups upon the basis of Occupational Level. Inspection of the table reveals the groups are not as clearly differentiated here as they were by Masculinity-Femininity. Three of the six critical ratios are, nevertheless, significant beyond the two-per-cent level of probability. Both measured and expressed interest groups again are differentiated. The skilled trades interest groups have a significantly lower mean score on the Occupational Level key, as would be expected.

Students were asked to list the jobs they held prior to coming to the Testing Bureau. A preliminary interviewer also asked them for their work experience as a check upon their response to the item on the questionnaire.

Of the ninety-two students having measured interest in business, thirty-nine per cent had experience on some sort of business job—clerking, bookkeeping, salesman, etc., while only twenty per cent of the forty-four students with no measured interests in

TABLE 4.—MEAN SCORE, STANDARD DEVIATION AND NUMBER OF CASES ON OCCUPATIONAL LEVEL KEY OF STRONG INTEREST BLANK FOR VARIOUS INTEREST GROUPS

GROUP	MEAN	SD	*N*	CR
Measured interest in Engineering	3.14	49.11	42	
Measured interest not in Engineering	23.85	45.30	92	2.32
Measured interest in Business	18.29	45.98	90	
Measured interest not in Business	15.45	50.44	44	.31
Measured interest in Skilled Trades	3.84	42.22	70	
Measured interest not in Skilled Trades	43.86	38.30	64	5.75
Measured interest in Social Welfare	16.13	43.98	40	
Measured interest not in Social Welfare	25.86	45.22	94	1.16
Expressed interest in Engineering	−.91	49.10	55	
Expressed interest not in Engineering	30.33	41.72	79	3.85
Expressed interest in Business	29.19	35.47	32	
Expressed interest not in Business	13.65	50.13	102	1.94

business had this experience. The students having expressed interest in business also had more experience in this field than students without this interest. The business interest groups are the only ones who apparently show a relationship between their work histories and their vocational interests. This might be related to the family factor, as many sons of business men received their experience while working for or with their fathers. Of the one hundred thirty-six students, only twenty-one, or fifteen per cent, indicated they had work experience related to their chosen occupation. All but thirteen, however, had some work experience; but this usually consisted of miscellaneous jobs—cutting grass, selling newspapers, life-saving, etc.

A list of fifty-six activities was presented to each student who was asked to encircle those in which he engaged frequently, either in high school or at the time of coming to the Testing Bureau. These activities were:

Individual "athletic" activities—tennis, golf, fishing, hunting, hiking, riding, swimming, ping pong, boxing, handball, skating, bicycling, bowling.

Individual "passive" activities—movies, billiards, pool, listening to radio, stamp collecting, auto riding, woodworking, cooking, modelling.

Individual "cultural" activities—reading, theatre, concerts, art museums, lectures, dance recitals.

Team "athletic" activities—football, baseball, basketball, volleyball, hockey.

Social activities—dancing, dates, bridge, poker, picnics.

Group "cultural" activities—dramatic organizations, music organizations, discussion groups, debating organizations, political organizations, literary organizations.

Organizational activities—Y.M.C.A., Boy Scouts, De Molay, high-school or college secret society, fraternity.

Religious activities—church attendance, Sunday-school attendance, Sunday-school teaching, participation in young people's society of some church, sing in church choir.

None of the interest groups is differentiated by the individual or team athletic activities. The interest groups were not differentiated upon the basis of individual passive activities. The groups were not differentiated upon the basis of organizational activities.

The group expressing an interest in business indicated they participated in more social activities than did the group without this interest. The difference between the means of the two groups was statistically significant between the five- and one-per-cent levels of probability. Both engineering interest groups showed themselves less socially inclined, but the differences were not statistically significant. Students with interests in engineering participate in fewer religious activities, the trends being statistically significant only for the measured interest group. The group with measured interests in the social welfare field participate in significantly more religious activities than does the group without these interests. Students with measured and expressed interests in engineering participate in significantly fewer group cultural activities than do students without these interests, while students with measured interests in the social welfare fields encircle significantly more group cultural items than do other students. As would be expected, students with measured interests in the skilled trades check fewer group cultural activities than do other students. Neither measured nor expressed interests in business appear to be closely related to the cultural activities of students.

Results involving individual cultural activities are not as clear cut, although the trends are the same. Students with measured interests in engineering participate in significantly fewer individual cultural activities than do students without these interests.

The interest groups were also compared upon the basis of the mean number of activities participated in while the students were in high school. The students were asked to specify the

types of extra-curricular activities on a questionnaire and this information was also obtained by the preliminary interviewer. For each student the number of activities was counted and duplication eliminated. The engineering interest groups participated in fewer activities than the non-engineering interest groups, the difference being statistically significant for the measured interest pair. The measured social welfare interets group participated in significantly more activities than did the group without this interest, and the business interest groups tended to participate in more and the skilled trades measured interest group tended to participate in fewer activities.

Students were asked to list their hobbies. These hobbies were then classified according to their relationship to the students' measured and expressed interests. Of the students having measured interests in engineering, twenty-three, or fifty-five per cent, indicated they had related hobbies, while only fifteen, or sixteen per cent, of the students without these interests indicated they had hobbies related to engineering. Of the ninety students having measured interests in business, thirty-two per cent had related hobbies, while of the forty-four without these interests, only eighteen per cent had hobbies related to business. Of the seventy-one students having measured interests in the skilled trades, forty-six per cent had related hobbies, while only twenty-eight per cent of the sixty-five students without these interests had hobbies related to the skilled trades.

Hobbies also appear related to expressed vocational interests. Of the fifty-six students expressing an interest in engineering, forty-eight per cent had related hobbies, while of the eighty expressing no such interest, only fourteen per cent had hobbies related to engineering. The results suggest a substantial relationship between both expressed and measured vocational interests and the activities and hobbies of a student. Whether the interests and activities co-determine each other, or whether they are paralleled expressions of a unified personality exposed to a given set of conditions is unknown.

The students were asked for the subject taught by their favorite teacher in high school. Of the forty-two students with measured interests in engineering, only two, or five per cent, indicated their favorite teacher taught social sciences, while eighteen per cent of the ninety-four students without these

interests indicated their favorite teacher taught the social sciences. The trends are similar with the expressed engineering interest group. Of the students with measured engineering interests, twenty-nine per cent indicated their favorite teacher taught mathematics, while of the group without these interests, only fourteen per cent indicated their favorite teacher taught mathematics. The difference was even greater for the expressed engineering interest group. Relatively more of the students having measured interests in the skilled trades and relatively fewer of those having measured interests in social welfare indicated their favorite teacher taught mathematics. Fewer of the engineering interest students and skilled trades interest students checked their English teacher as their favorite, while relatively fewer of the measured social welfare interest group and expressed business interest group indicated their favorite teacher taught mathematics.

An association can thus be demonstrated between measured and expressed vocational interests and liking for teachers. This does not indicate teachers influence vocational interests, for it can also mean students like those teachers who teach subjects which are of greatest interest to them.

VALUE FACTORS AND INTERESTS

The preceding presentation of the results suggests that vocational interests are extremely complex phenomena which will not be completely understood through a consideration of relatively simple factors, such as home, ability, hobbies, etc. Vocational interests, interpreted as personality expressions, will undoubtedly share in those subtle associations generally attributed to personality. Studies similar to Murray's, Dollard's, and others indicate that understanding of behavior might be increased by broadening the approach of the investigator, that is, by attempting to observe simultaneously many of the factors previously regarded as separate segments of the personality-situation pattern. Previous authors have recognized that mere observation can increase our understanding of personality, but that observation plus systematization and quantification can do even more.

After the relatively isolated factors just reported here were studied, an exploratory attempt was made to observe the relatively

more complex factors related to interests. These broader factors which have been investigated in relation to interests are called 'value factors.' They consist of those situations, objects and experiences the individual uses as points of reference in answering certain questions. The mention of a person or a thing or an experience in answer to a question regarding an emotional reaction indicates that person, thing or experience has acquired a certain 'value' for that individual. When a student states at different times that losing a football game was the most disastrous thing that ever occurred to him, that in ten years he would like to be a baseball star, and that his most pleasant surprise was a new pair of skates, we can infer that athletic activities have acquired a 'value' for him.

We can not directly measure the values things have for different individuals. We can, however, ask a series of questions directed at ascertaining those things valued most by different individuals and, upon the basis of this, make group comparisons. That is what was done in this study. A series of questions was presented, which, for the most part, called for limited, free response answers. After the answers were collected, they were classified in categories of a restricted nature.

The people who possess 'value' for a student may be related to his vocational interests. Many occupational choices are influenced by hero worship and other personality manifestations might also be. Students were asked for the sex and occupation of the acquaintance they admired most and of the person (whether they knew him or not) whom they admired most.

None of the differences between groups reach statistical significance. Students tend to most admire other students among their acquaintances. They also admire people in the social-contact field, usually teachers. The occupation of their most admired acquaintance bears little relationship with their vocational interests and there is little to suggest that students tend to identify themselves vocationally with people they know. There is a tendency for students to most admire people with whom they are *not* acquainted who are in fields of work related to their vocational choices.

Many factors besides people possess value for individuals, and these factors may furnish some information regarding the correlates of vocational interests. A series of questions were asked

the students in this study to ascertain what some of these factors might be. Again, limited answer free response type questions were used. Students were asked to list:

The three things contributing most to their happiness
The three things contributing most to their unhappiness
The thing liked most about their present way of living
The thing disliked most about their present way of living
The most pleasant experience they have had
The most unpleasant experience they have had
What they would like to be doing in ten years
Valued things they have lost
Failures they have had in things in which they wished to succeed
Types of surprises they have had

Of interest are the numbers of students in each interest group mentioning different types of conditions contributing to their happiness. Of the forty-two students with measured interests in engineering, twenty-one per cent listed items related to school or education, while of the group without these interests, only nine per cent did. Relatively fewer of the students with measured interests in business mentioned school items. Of the group with measured interests in engineering, five per cent mentioned money or financial conditions, while of the opposed group fifteen per cent did. Of the measured business interest group, fifteen per cent mentioned money items, while only five per cent of the opposed group did. The expressed business interest group tends to mention friends fewer times and "other things" more often. Of the skilled trades interest group, forty-six per cent mentioned their family as a factor contributing most to their happiness, while only twenty-eight per cent of the group without this interest mentioned their family.

Trends of the numbers of students in each interest group mentioning different factors as contributing to their unhappiness are comparable. Of the forty-two people with measured interests in engineering, seven per cent mentioned "other people" (friends, teachers, etc.), while of the ninety-four students with no measured engineering interests, twenty-four per cent mentioned other people. The difference was comparable and in the same direction for the expressed engineering interest groups. The people with both measured and expressed interests in business tended to mention "other people" more often than did the people without these interests. They tended to mention

their families less often. People with interests in the skilled trades tended to mention "work" less often (three per cent of the skilled trades interest group, fifteen per cent of the no interest group), and to mention "other people" less often (thirteen per cent and twenty-six per cent). The social welfare group mentioned "money" less often (five per cent and twenty-two per cent) and "future insecurity" less often (three per cent and fourteen per cent).

These differences between percentages are not statistically significant due to the few cases and the small percentages involved. They do suggest, however, that different interest groups may vary in the answers they give to free response, limited answer questions and that many of these differences are parallel with the common stereotypes. People with interests in business attach greater value to money, people with interests in engineering attach greater value to school.

Students were asked to check a list of reasons for making their vocational choices. Of the thirty-two students with expressed interests in business, twenty-two per cent indicated this choice was influenced by financial factors, while of the one hundred four students without this interest, only seven per cent checked this item. Of the group with expressed interests in business, three per cent chose business because it held most intellectual interest, while of the students choosing other occupations, twenty per cent chose them because they were intellectually exciting. Students choosing business apparently recognize a lack of intellectual challenge connected with this field, but this is compensated for by the financial advantages.

The relationships between responses to other "value" questions and interests were analyzed in a similar manner.

SUMMARY OF FACTORS ASSOCIATED WITH VOCATIONAL INTERESTS

Expressions of personality—measured interests, expressed interests, measured values, and value self-estimates—are not chaotic phenomena haphazardly influenced by the superficial and accidental events and experiences of the individual. Rather, they appear to be ordered manifestations of a basic, fundamental structure. They are related to one another and sometimes these relations can be fairly clearly defined, as is the case with measured interests and measured values. Other times, this definition

is not as clear, but enough evidence can be found to show that such relationships do exist and that interests may be regarded as one phase of a unitary personality matrix.

Personality is a product of many conditions. Part of these conditions are biologically inherited, the glands, for instance; part are socially inherited, religion, for instance; and part are acquired from chance contacts with environmental factors, one's teachers, for example. Although few of the results presented here are conclusive, several of them do supply hypotheses about vocational interests. These results may be summarized:

(1) Sons of skilled tradesmen tend to have measured vocational interests similar to the interests of skilled tradesmen and engineers, *i.e.*, technical interests. They do not have measured interests in social welfare nor expressed interests in business, but they tend to have expressed interests in engineering.

(2) Sons of business men tend not to have measured or expressed technical interests but tend to have measured and expressed business interests.

(3) The occupations of mothers tend not to influence the vocational interests of their sons.

(4) People with technical interests tend to come from low income families while people with business interests tend to come from high income families.

(5) Students with measured interests in engineering have greater measured ability than others. Other vocational interests do not appear related to ability.

(6) People choosing business have slightly higher morale scores than do others.

(7) Students with measured and expressed interests in engineering obtain low social adjustment scores, as do people with measured interests in the skilled trades.

(8) Students with measured interests in social welfare obtain higher social adjustment scores and higher emotional adjustment scores.

(9) No relationship is apparent between economic conservatism and vocational interests.

(10) Measured and expressed vocational interests are related to Masculinity-Femininity and Occupational Level.

(11) Students with expressed and measured interests in business tend to have had related work experience.

(12) Students choosing business participate in more social activities (perhaps due to higher economic status).

(13) Students with interests in engineering participate in fewer religious and cultural activities, while students with measured interests in social welfare participate in more.

(14) The total number as well as the types of activities in which a student participates are related to vocational interests.

(15) Hobbies are related to expressed and measured vocational interests.

(16) Students with interests in engineering tend to consider their mathematics teacher as their favorite teacher.

(17) A relationship is suggested between the student's self-estimated special abilities and vocational interests.

(18) Business interests are accompanied by greater values attached to money and the things money will buy.

This summary suggests that these results are not independent among themselves. Interrelationships are known to exist between occupation of father, intelligence of children, economic level of family, education of mother, etc.

In conclusion, an attempt will be made to describe different sets of conditions, each of which is most likely to be associated with a given interest type. The effects of some of these conditions are quite predictable, the effect of most of them highly problematic.

Students with measured vocational interests similar to the interests of engineers are likely to come from families with relatively low incomes. Their fathers will tend to be skilled tradesmen and not business men. These students will most likely have superior ability, but be lacking in social interests or skills. They are also likely to have masculine interests and to have interests typical of those of men in lower level occupations. They will have participated in relatively few cultural and religious activities and in few extra-curricular activities in high school. They will exhibit hobbies related to engineering—woodwork, model planes, etc., and claim to have related special abilities—drawing, mechanical, and mathematical. In high school their favorite teachers taught mathematics and they were not enthusiastic about their English and social science teachers. They tend to admire people in engineering and fewer of their values center about people.

Students who choose engineering as their future occupation will tend to come from the same types of homes and families as students with measured engineering interests. Similarly, they will have fewer social interests and skills, and will have masculine interests typical of men in lower level jobs. They will tend to underline adjectives which describe their personalities favorably and will participate in few cultural and religious activities and few extra-curricular activities in high school. Their hobbies will also be related to engineering.

The above two paragraphs suggest that many factors are common to both measured and expressed interests in engineering.

Students with measured vocational interests similar to the interests of men successful in business will tend to come from relatively high-income families and have fathers who are business men. They will tend to have had work experience related to business and their hobbies will also tend to bear some relation to business. They will most likely have many social interests and skills and people will be considered to possess important value in their lives. Their values will also tend to center around their homes and financial factors.

Students who choose business as their future occupation are likely to have fathers who are business men with superior incomes. They tend to have had work experience related to business. They will probably have many social interests and skills. Relatively few of these students consider their mathematics teacher as their favorite teacher. They tend to admire business men, participate in more social activities and place a greater value upon monetary and material factors.

Students with measured vocational interests similar to the interests of men successful in the lower-level occupations, such as the skilled trades, tend to have fathers in these occupations. Few of them will have fathers who are businessmen. They will tend to come from families with low incomes and their interests will be similar to those of men in the lower-level jobs, in terms of their occupational level score. Their interests will tend to be masculine. Their hobbies will tend to be related to their measured interests and they will most likely have few social interests and skills. Their favorite teacher in high school most likely taught mathematics and not English. They claim to possess

no special abilities and tend to admire men in the technical and engineering fields.

Students with measured vocational interests similar to the interests of men successful in the social-welfare fields will tend to be interested in people and social activities and to be emotionally stable. They will describe their own personalities favorably, and their measured interests will tend to be feminine. They will participate in more cultural and religious activities and will tend to have been more active in extra-curricular activities in high school. Their favorite teacher in high school most likely will not have been their mathematics teacher. They will tend to claim no special abilities.

The descriptions in this section are based primarily upon measures of central tendency and do not emphasize the wide variation found in every vocational interest group. Many types of engineers can be found, salesmen, technical scientists, and business executives. The same is true for businessmen. We must remember that here we are paying little attention to intra-occupational differences. We must also remember the above results were determined on individuals drawn from the student body of a large state university and generalizations must be made with caution.

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CONCEPTIONS AND BELIEFS SIGNIFICANT TO THE FIELDS OF MENTAL HYGIENE AND SOCIAL WELFARE OF SENIOR PRE-MEDICAL PSYCHOLOGY STUDENTS

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This study of conceptions and beliefs significant to the fields of mental hygiene and social welfare of senior pre-medical psychology students was carried out in the conviction that the accumulation and dissemination of such results as those presented here should eventually lead to considerable improvement in the education of prospective doctors.

THE SUBJECTS

The subjects who provided the data for this study were one hundred forty-one of the one hundred forty-nine pre-medical seniors who were beginning their last years of undergraduate work as members of several successive senior classes in a moderate-sized college located in the Southeast. The college was representative in the academic ability of its entering freshmen classes, according to results obtained on the *American Council Psychological Examination*, of other colleges and universities in the region. It was one in which about forty-five per cent of the entering freshmen, on the average, survived to reach their senior years. The subjects were, apparently, slightly better than representative in their previous college achievement of all the seniors in classes to which they belonged, according to the official achievement ranks they had been given in those classes.[2] To be more specific; when these pre-medical seniors were arranged, according to their computed percentile ranks, in a single distribution, the median subject in the group was one with a percentile rank of 52 and the middle fifty per cent of the group possessed percentile ranks ranging from 33 to 77. Most of the subjects

[1] The following students coöperated in tabulating the results: H. K. Boyd, H. E. Blake, B. M. Dukes, C. H. Gibson, S. H. Jones, C. T. Smith, J. W. Thurlow, R. E. Tomlinson.

[2] The ranks used, when available, were those prevailing at the time of graduation; otherwise those held at the beginning of the senior year. This study showed that it made little difference which base was used.

have already been graduated or could normally expect to be graduated.

The pre-medical course taken by these subjects was largely prescribed and ran heavily to chemico-physical science. Three of the four years of required chemistry and the one or two years of required physics had been covered by most of the subjects; so had one of the two years of offered and required biology—a course in zoology. This course included human physiology. The biological course yet to be taken was one in comparative vertebrate anatomy. Only a few had taken previously any college sociology and very few had taken any psychology.

THE TEST AND ITS ADMINISTRATION

The entire test used in the investigation consisted of one hundred eighty statements; the fifty-eight statements considered pertinent to this particular study form part of Table I. The statements presented were designed to reveal the prevalence of certain conceptions, misconceptions, and unfounded beliefs considered significant in the fields of mental hygiene and social welfare. Sources of information used in the formulation of these test items included: (*a*) psychology texts, (*b*) various studies of superstitions and unfounded beliefs made by a number of investigators, (*c*) somewhat similar studies made collaboratively by the writer,[1] and (*d*) some knowledge of the misconceptions of students in psychology gained in the teaching of such students. Obviously, only a fraction of the fields involved could be covered by the limited number of test items. No claim is made that the selection of the concepts and beliefs to be dealt with was made in a manner highly objective or lacking in arbitrariness; nor is there any claim that all of the test items are fully satisfactory.

Considerable care was exercised in the administration of the test to secure thoughtful consideration of the test items and intellectually honest reactions to them. With this dual end in

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[1] Ralya, Lynn L. and Ralya, Lillian L.: "Some Concepts and Beliefs Significant to the Social Sciences of Entering Freshmen and the Relation of These to Scholastic Aptitude." *Social Forces*, Vol. xx, No. 3, March, 1942; "Some Significant Concepts and Beliefs in Biology and Anthropology of Entering Freshmen." *Science Education*, Vol. xxv, No. 6, November, 1941; "Some Misconceptions in Science Held by Prospective Elementary Teacher." *Science Education*, Vol. xxii, No. 5, October, 1938.

view, the subjects were told of the value of such studies and, at the same time, assured that they were required only to do a conscientious piece of work. They were also assured that they would be given all of the time that they found necessary, and that neither the general nor any specific results would be used in rating them or even connected with their names. The precaution was even taken of calling the test a 'psychology inventory' in an attempt to avoid whatever undesirable reactions might have been aroused by the label 'test.' Furthermore, a more favorable attitude toward the project was also sought by allowing the subjects to indicate the statements about which they were uncertain—the directions calling for a choice of one of the three responses: (*a*) believe, (*b*) disbelieve, or (*c*) uncertain.

TREATMENT OF DATA

Each of the fifty-eight test statements of the study was considered to be either true or false in accordance with the writer's judgment of the probable interpretation given to it by the subjects and in accordance with his conception of current psychological knowledge or estimate of the consensus of authorities. The per cent of the subjects considered incorrect in their response to each statement was computed for: (1) the entire group of one hundred forty-one subjects; (2) the group of forty subjects ranking lowest in their general college achievement; and (3) the group of forty subjects ranking highest. In this computation those subjects who indicated uncertainty were included among the incorrect. This allowed a simpler, if less accurate, presentation of the results. The ratios of the number of subjects definitely in error to the number uncertain was computed for each statement and ranged from 4.1 to .5 for the middle eighty per cent of a distribution of such ratios. Table I gives the test statements, the key used, and the results obtained.

INTERPRETATION OF RESULTS

Interpretation of the results obtained on the individual test statements, or even on groups of them, is inevitably a venturesome undertaking. The statements are out of their normal modifying setting and, of course, could have had the same meanings for all subjects only to the extent that their pertinent experiences had been alike. The statements also represent conceptions

TABLE I.—TEST STATEMENTS AND SUBJECTS CONSIDERED IN ERROR

No.	Statement	Per Cent of Subjects Considered in Error			
		Key	All 141	Low 40	High 40
1	All mental ailments are traceable to physical causes.....	F	34	33	33
2	Most cases of stammering can be cured by an operation...	F	41	38	35
3	People can be divided into two distinct classes: the mentally normal and the mentally abnormal.....	F	58	63	63
4	All people may be classified into groups: extroverts and introverts.....	F	63	68	48
5	Any physical or mental disease can be contracted by thinking too much about it.	F	26	31	21
6	Not all diseases are due to germs.....	T	29	36	26
7	Women are purer by nature than men.....	F	43	45	38
8	If a pregnant woman is frightened her child may be born marked.....	F	44	53	35
9	Some people are born with an impulse to jump from high places.....	F	66	78	63
10	A child's fear of snakes is inherited from his remote racial ancestors.....	F	30	30	20
11	A child is born with a fear of fire.....	F	11	8	8
12	Thinking involves inhibition..	T	62	80	50

TABLE I.—*Continued*

No.	Statement	Per Cent of Subjects Considered in Error			
		Key	All 141	Low 40	High 40
13	The learning of a mechanical skill involves inhibition....	T	74	80	73
14	All repressions are harmful to the individual.....	F	29	18	23
15	A person may be active mentally when he seems to be absent-minded.....	T	6	13	3
16	Many of our beliefs are due to prejudices.....	T	9	13	3
17	Many conclusions we come to are the result of wishful thinking.....	T	18	15	20
18	All emotional instability is due to improper glandular functioning.....	F	49	53	50
19	In order to lead a balanced life one should avoid all emotional experience.....	F	5	5	5
20	The best way to regulate our emotions is to keep them entirely separate from our intellects.....	F	57	68	45
21	Any emotional attachment of an individual for a member of the same sex is more often harmful than not.....	F	70	75	65
22	The association of young boys in gangs is harmful and should be prevented if possible.....	F	15	10	13
23	Many habits are desirable....	T	11	15	8

TABLE I.—*Continued*

No.	Statement	Per Cent of Subjects Considered in Error			
		Key	All 141	Low 40	High 40
24	Ideals are psychologically related to habits	T	30	25	35
25	Many people attempt to compensate for a physical handicap by excelling over their fellows in some way	T	6	8	8
26	A person with an inferiority complex may appear to be very egotistic	T	34	35	30
27	A 'complex' is always undesirable	F	40	43	25
28	Only the insane have delusions	F	11	13	5
29	The soundest sleepers seldom, if ever, dream	F	60	60	68
30	The material of dreams relates to the past rather than to the future	T	57	63	48
31	Objects in dreams always have a symbolic meaning	F	30	30	20
32	During the best sleep there is no movement of the body	F	47	48	50
33	Being hypnotized weakens the will	F	67	70	58
34	A person under hypnotic influence can be made to commit any crime	F	59	73	55
35	Feeblemindedness is inherited as a unit trait	F	70	70	73
36	Feebleminded children almost always have physical deformations such as hair-lip, hammer-toes, club-feet, etc.	F	40	45	33

TABLE I.—*Continued*

No.	Statement	Per Cent of Subjects Considered in Error			
		Key	All 141	Low 40	High 40
37	It is easy to separate people of sub-normal intelligence from those of average intelligence by means of simple tests	F	78	85	75
38	Feeblemindedness is sometimes caused by birth injuries	T	26	21	26
39	Feeblemindedness is sometimes due to improper glandular action	T	18	15	23
40	Some cases of feebleminded are caused by over-study	F	56	60	45
41	Feeblemindedness is generally due to poor environment and lack of opportunity to learn	F	31	31	26
42	Some cases of mental deficiency can be remedied	T	12	13	15
43	A person who has had very few sensory experiences because of isolation may appear to be feebleminded	T	37	33	28
44	Feeblemindedness can be cured by expert training	F	57	56	46
45	Many eminent men have been feebleminded in childhood	F	53	64	36
46	Morons are always immoral	F	22	30	13
47	Criminals may be classified into several born-criminal types	F	36	38	25

TABLE I.—*Continued*

No.	Statement	Per Cent of Subjects Considered in Error			
		Key	All 141	Low 40	High 40
48	The great majority of criminals are feebleminded.....	F	35	50	30
49	Certainty of punishment is more important than great severity of punishment in the prevention of crime....	T	24	28	20
50	Children of first cousins are always inferior.....	F	31	48	25
51	Children of parents of different races are always inferior	F	20	28	15
52	A receding chin is a sign of lack of will power.....	F	25	33	18
53	Shifty-eyed people are likely to be dishonest.....	F	24	25	20
54	The conscience is an infallible guide to conduct.....	F	53	64	31
55	Man instinctively knows the difference between good and evil.....	F	36	33	23
56	The conduct of an individual can often be predicted if we know his character.....	T	10	18	3
57	A man's character is determined by both his heredity and his past experience....	T	21	23	13
58	Many social rules are basically economic.....	T	24	23	23

and beliefs of different degrees of individual and social significance, and failure, say, of a small number of subjects on one of them may represent a more severe deficiency than failure of a large number on another. Nor can the fact that some state-

ments represent controversial issues be overlooked. Nevertheless, interpretations must be ventured by writer or reader, or both, if the results are to have value, although space limitations preclude consideration of all of them here.

The results on items 3, 4, and 47, considered together, are interpreted as indicating an acquiescence on the part of many of these subjects in the bi-modal or discrete-type fallacy, an acquiescence which probably extends beyond these specific manifestations of it to other situations. Since this fallacy is one which is capable of rendering less valid the thinking concerning any, or all, human abilities and characteristics, it is a serious one. It should be noted that the failure of the group high in general college achievement was as great as that of the low group on one of the items (3),[1] although somewhat less on the other two (4, 47).

A number of items are devoted to the cause and cure of physical and mental disease. Attention is called to the fact that about one-fourth of the entire group of subjects failed to accept the statement that not all diseases are due to germs (6) and to the fact that about the same number failed to reject the statement that any physical or mental disease can be contracted by thinking too much about it (5). It is deemed worthy of note that the failure of the high group was not as great as that of the low group on the two items.

According to the results on items 1 and 2 considered together, and on item 1 especially, it would seem that about one-third of the subjects had failed to reach an appreciable degree of understanding and belief that some mental ailments, at least, are functional in nature. Since more than a majority of the types of mental ailment or abnormality are assumed to be functional rather than organic, and preventable or curable (if curable) in accordance with this assumption, a weakness needing considerable educational attention was revealed—especially as the subjects were pre-medical students. It is to be noted that the failure of the group high in general college achievement was about the same as that of the low group.

It is worthy of note that a large number of these subjects (eighty per cent of the low group and half or more of the high group) failed to indicate recognition of the fact that inhibition is involved in thinking and in the learning of a mechanical skill

[1] The numbers in parentheses are the numbers of the test items in Table I.

(12, 13). Fortunately, the nature of the human organism and of society is such that much of the needed inhibition goes on in individuals whether they recognize or believe that it does. However, an increase in the understanding of its significance and manner of operation might improve its functioning and bring about a more harmonious integration of personality. Such understanding would also prevent the acceptance of that widely prevalent and individually and socially destructive doctrine of 'self-expression' which incorporates a denial of the need for inhibition, or even its outright dismissal as harmful. The statement that all repressions are harmful to the individuals was rejected by only twenty-nine per cent of the subjects (14).

Few of these subjects, it would seem, believed it desirable to avoid all emotional experiences, although a very large number of them failed to disclaim the desirability of keeping the emotions separate from the intellect (19, 20). In addition, many subjects failed to reject the statement that all emotional instability is due to improper glandular functioning, thus indicating probable failure to recognize the extent to which learning may enter into some cases of instability (18). It should also be noted that seventy per cent of the entire group, and nearly as many in the high group as in the low, failed to reject the statement that any emotional attachment of an individual for another member of the same sex is more often harmful than not (21). This failure would seem to indicate either incorrect interpretation by the subjects of the term 'emotional attachment' or subscription by them to the fallacy that the statement was designed to represent. The results reveal a significant deficiency in either case.

Items 29 through 34 refer to sleep, dreams, and hypnotism. Dreams have long been the object of superstitious regard. Attention is called especially to the fact that over half of the low group and nearly half of the high group failed to accept the statement that the material of dreams relates to the past rather than to the future (30).

The individually and socially important problem of inheritance is represented by items 8, 9, 10, 11, 35, 50, 51, and 57. It should be noted that, while only eleven per cent failed to indicate disbelief in the inheritance of one particular kind of fear—that of fire; thirty per cent failed with reference to the inheritance of another kind of fear—that of snakes (11, 10). Nor should the

high degree of failure on the item dealing with the inheritance of the results of pre-natal influence and the very high degree of failure on the item devoted to the inheritance of a supposed tendency to jump from high places be overlooked (8, 9).

The social problem of feeblemindedness was represented by a number of statements on the test, since it has been brought more into public consciousness in recent years in connection with so-called 'eugenic programs,' largely foreign in origin, which advocate sterilization as a panacea for all social ills (35–46, 48). The very high degree of failure on the items designed to test the belief that feeblemindedness is inherited as a unit trait and the belief that it is easily diagnosed should be noted (35, 36, 37). The success on the rest of the items varied greatly from one to another.

Three items are devoted especially to the problem of crime (47, 48, 49). It is of considerable significance that there was a fairly high degree of failure to reject the 'criminal type' fallacy, as represented by item 47, and to reject the fallacy that the majority of criminals are feebleminded (48). Acquiescence in these, and similar, fallacies is almost inevitably associated with failure to recognize the extent to which the criminal is a social product and crime preventable through the control of social conditions.

Attention is called to the rather high degree of failure to disclaim belief in the instinctive nature and in the infallibility of the human conscience (55, 54). It would seem that much unsound thinking concerning human behavior would be associated with the possession of such fallacious beliefs.

Concern thus far has been largely with the deficiencies in knowledge and belief revealed by the subjects. The picture of the results would not be complete or accurate without stating positively that there were some successes, in addition to those already specifically referred to, and pointing out some of the more important ones. Attention is consequently called to the fact that all but about ten per cent of the subjects would seem to have realized: (*a*) that many of our beliefs are due to prejudices, (*b*) that many habits are desirable, (*c*) that compensation for a physical handicap often occurs, and (*d*) that delusions are not limited to the insane (16, 23, 25, 28). Study of Table I will reveal additional successes as well as additional weaknesses.

SUMMARY AND CONCLUSIONS

The prevalence of certain concepts and beliefs significant to the fields of mental hygiene and social welfare has been determined with some degree of objectivity for: (1) an entire group of one hundred forty-one pre-medical seniors, (2) the group of forty ranking lowest in general college achievement, and (3) the group of forty ranking highest. Attention has been specifically called to some of the more serious deficiencies and important successes in understanding and belief. A study of Table I will reveal others.

As would be expected, the failure of the group high in general college achievement was less than that of the low group on a majority of the items. However, the failure of the high group was as great as or even greater than that of the low group on a considerable number of items—on about one-fourth of them to be more exact. Furthermore, the failure of the high group was sometimes seriously high on important concepts and beliefs on which the failure of the low group was even greater. There were also important successes by even the low group. It should also be noted that there was wide variation in the degree of failure from item to item—even in the case of closely related ones. Predictions based upon knowledge of the levels of general college achievement of these subjects concerning the prevalence among them of the concepts and beliefs with which this study is concerned would not have been very reliable. It would seem that there is but one way to determine the prevalence of such conceptions and beliefs, and that is to test specifically for their prevalence in some such way as that represented in this study.

THE RELATIONSHIP OF VARIOUS EYE CONDITIONS AND READING ACHIEVEMENT[1]

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When there are as many variables in such a complex achievement as reading, it would be unreasonable to assume that any function can be altered from the normal development in that process without influencing somewhat the entire peripheral ocular mechanism as well as the central perceptual and conceptual processes. The degree to which these abnormal functions, which are demonstrable, influence the process as a whole depends upon the ability of the individual to integrate the associated movements of the peripheral ocular mechanisms, which vary among themselves, and accordingly adapt themselves to the physiological and psychological needs or contingencies or stimuli that exist at any particular time. The degree of this homeostatic[2] stability depends on the relative degree of normality of all the diverse activities which are synthesized into the whole conscious reading achievement.

It is fully realized that to select an isolated function such as vision and claim it to be the sole causative factor without considering the various other findings in relation to the child as a whole would be erroneous. In this work it is hoped that some clue will be found as to what influence the visual function has upon reading achievement. Discretionatory judgment must be used in analysing the probable causative factors in any case of reading difficulty, *i.e.*, in studies referring directly to the status, fitness or condition of the reader, the following must be considered as representative:[3] Emotional disturbances; endocrine

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[1] The writers wish to express their appreciation to Professor Alfred Schmieding, Dr. Daniel P. MacMillan, Dr. Sanford R. Gifford, Miss Anna McNichols, Miss Dorothy Kuhns, and Miss Laverne McGough for their help and criticism in this work.

[2] Cannon, W. B.: *The Wisdom of the Body*, 2d edition, New York: W. W. Norton & Company, 1939.

[3] MacMillan, Daniel P.: "Dyslexia," *Journal of the American Institute of Homeopathy*, Vol. XXXIII, No. 3, March, 1940, p. 136.

imbalances; nutritive depressions; the reading readiness of the child; nervous disorders; defective intelligence. Also one must consider and emphasize the methods as used in learning and teaching. A few references we hope will suffice as examples for consideration: the acquisition of an adequate background of vocabulary as a requisite for beginning reading and achievement; personality traits and reading habits; the experience, motives and interests of poor readers; the transition from oral to silent reading; combined visual kinesthetic and phonetic activities; motivated free *versus* controlled reading.

HISTORY

Prior investigators have as a rule selected a group of poor readers and attempted to correlate ocular abnormalities or grouped their subjects according to the diagnosis of ocular defects and tried to determine any correlation between the ocular defects and reading performance.

McFarland, Knehr and Berens[1] found little or no correlation between extent of coöperation of the two eyes as measured by vergence changes and the phorias both for a control group and for a series of clinical patients. Neither was there any apparent correlation between their findings and the direct measurements of reading efficiency.

Imus, Rothney and Baer,[2] in a preliminary study of several hundred students found subjects when grouped according to a diagnosis of ocular defects showed no significant differences in gains or performance on the reading test.

Stromberg[3,4,5] found almost identical distribution of exophoria and esophoria between fast and slow readers; however, fast

[1] McFarland, Knehr and Berens: *American Journal of Ophthalmology*, Vol. xx, 1937, pp. 1204–1221.

[2] Imus, Rothney and Baer: *An Evaluation of Visual Factors in Reading.* Dartmouth College Publications, 1938. The Dartmouth Eye Institute of the Dartmouth Medical School.

[3] Stromberg: "The Relation of Lateral Muscle Balance and the Ductions to Reading Speed." *American Journal of Optometry*, Vol. xiv, 1937, pp. 415–420.

[4] Stromberg: "The Relationship of Measures of Visual Acuity and Ametropia to Reading Speed." *Journal of Applied Psychology*, Vol. xxii, 1938, pp. 70–78.

[5] Stromberg: "Binocular Movements of the Eyes in Reading." *Journal of General Psychology*, Vol. xviii, 1938, pp. 349, 355.

readers consistently showed higher ductions. He also found that acuity and ametropia are of little consequence so far as reading speed is concerned. Furthermore, he found no difference between fast and slow readers in respect to vergence movements.

Ames,[1] concluded that the speed of recognition of words, pictures, or objects is influenced by visual deficiency.

This is the first of a series of reports of an extensive study in which a group of two hundred fifty grade-school students received mental achievement tests and a fairly complete eye examination to include visual acuity, refractive errors, fusion, stereopsis, phorias and ductions.

PURPOSE

The purpose was to determine what type of eye conditions were present in a group of school children selected at random; to correlate the relationship, if there is any, between reading accomplishments and eye conditions; and to analyse the effect of various eye abnormalities on the reading accomplishment.

This paper will deal with the relationship as enumerated above of the eye conditions in toto to reading accomplishment rather than discuss separately any one individual function. In other words it will deal entirely with the 'over all' influence which the eye conditions, as found by the writers' examinations, have on reading. The group analysis and the effects of abnormal eye conditions on reading difficulties will be presented in subsequent reports.

PROCEDURE

In order to get an unselected group of children, two hundred fifty students from one of Chicago's public schools were picked at random for testing. The only selective factor was that only those students were tested whose parents gave permission for the examination. Every student tested brought from his parents a written authorization for the eye examination. A total of two hundred fifty students varying from the first to the eighth grade was thus obtained, and every child had a complete refraction with homatropine hydrobromide as the cycloplegic and followed

[1] Ames: "The Speed of Picture Recognition and the Speed of Word Recognition in Cases of Reading Difficulty." *American Journal of Ophthalmology*, No. 21, 1938, p. 1370.

by a post-cycloplegic examination. The eye examinations were made before any knowledge was obtained of scholastic achievement. During the initial examination the visual acuity was recorded and the refraction under homatropine was completed. The following week the post-cycloplegic check was made and the muscle tests performed. At that time it was determined whether or not the student should have glasses, or where he already had glasses whether they needed changing in any way. The criteria by which glasses were prescribed were, a half a diopter of hyperopic astigmatism or one diopter of simple hyperopia. Even in hyperopia of from one to one-and-a-quarter diopter if there was an exophoria the subjects would be allowed to go without glasses. For myopia anything more than −.25 diopters the subject was scored as needing glasses. If, according to the ophthalmologist's judgment, it seemed advisable that the student should have glasses, or that his glasses should be changed, the parents were so notified and advised to take the child to their eye doctor. No glasses were prescribed except to those who were sponsored by the Parent-Teachers Association of the school and which were paid for by that organization.

After a careful check for phorias by the cover test, the muscle balance was then checked with the Maddox Rod and red light, at both twenty feet and thirteen inches. For near vision a small pinpoint light was held in front of the student. The source of light was from a small flashlight attached to a string exactly thirteen inches long. In this way the distance from the child could be held constant and measured quickly. The aperture on the flashlight was only a few millimeters in diameter in order to force precise accommodation. The phorias were recorded for near and distance. If the child wore glasses the measurements were made with his correction only, since we were interested in obtaining the individual's eye status under which he had been studying rather than in making an eye examination for corrective purposes, except for glasses.

During the duction measurements care was taken with each individual to obtain accurate reports where the image separated and diplopia appeared and the point of recovery, *i.e.*, where the two images fused again. Adduction and abduction measurements were made for near and for distance and the tests were under the same condition as the phoria tests. Our standards for

ductions were considered quite flexible, however, for the sake of scoring the statistical work we considered the ratio of three to one between adductions and abductions for distance, and equal for near. The lower limit for a passable adduction for distance being twenty-four with a return at sixteen. Approximately equal strengths of the rotary prisms were used before each eye.

Lastly, a check of fusion and stereopsis was made with the stereoscope. Two fairly simple cards were selected, one for testing superposition of dissimilar images and the other for fusion and stereopsis. If a student had difficulty in fusion, as evidenced by inability to fuse the simple cards, a determination was made of the degree of binocular vision, or, in other words, the degree of loss of fusion and stereopsis.

In order to compare the reading scores with the findings from the eye examinations, each eye defect was arbitrarily assigned a value of one point.

SCORES

Each deviation from normal was considered an eye defect. For example, if a student had low vision in one eye, an exophoria for near, and poor adduction for near and distance, that student received a score of 4 points. The more defects found in the examination the greater the score. Zero represented a completely negative examination, while 14 was the highest (and poorest) score possible. A score of 14 would indicate that the subject had poor vision in both eyes, phorias, poor fusion or no fusion at all and low ductions. This simple method of obtaining a total score of visual defectiveness was used because of the difficulty of combining into a single score the quantitative measurements of several different types of defects. The mean of the scores thus obtained was 5.80. We used the following for scoring:

Poor vision in one eye	1
Poor vision in both eyes	3
Need of glasses or need of change of glasses	3
Distance phoria, eso, exo, hyper, regardless of kind or size	4
Near phoria, same as for distant	5
Poor adduction distant	6
Poor abduction distant	7
Poor adduction near	8
Poor abduction near	9

Poor recovery distant adduction..... 10
Poor recovery distant abduction..... 11
Poor recovery near adduction..... 12
Poor recovery near abduction..... 13
Poor fusion, stereopsis, or no simultaneous binocular vision 14

For the reading examination the school furnished the necessary data. Since the school carries out a complete yearly testing program, complete records from various achievement, and intelligence tests were available. However, for this study only intelligence and reading scores were used. The reading scores employed were those from tests given during that particular school-year in which the eye examinations were made. Since in most cases the student received the reading test at the beginning of the year, there may be some discrepancy between his test achievement and his actual achievement at the time of the examination, assuming that he progressed in his reading ability. However, this time difference is probably of little consequence, particularly in the case of the older pupils, since with them it may be assumed that there was small additional progress in their learning to read, and in the case of the younger students any increase in reading achievement from the time of testing to the time of the eye examination would actually increase the significance of our findings.

Out of the two hundred fifty students who were given the eye examinations, two hundred twenty-five completed all the tests so that complete records were available. Some of the remaining twenty-five did not finish their eye examinations while others missed the intelligence test or the reading test. The conclusions of this paper are, therefore, based on data from two hundred twenty-five subjects.

TABLE I.—CLASSIFICATION OF TOTAL FINDINGS OBTAINED ON ALL THE CHILDREN AND THE NUMBER OF TIMES THE CONDITIONS NOTED WERE FOUND

GLASSES NECESSARY	EXOPHORIA	ESOPHORIA	DUCTION WEAKNESS	LACKING SIMULTANEOUS BINOCULAR VISION	NORMAL VISION	SQUINT
70	69	34	100	22	24	9

Table I gives the type of findings obtained on all the children. The figures do not represent the number of individuals but the number of times the conditions stated were found. A given subject may be represented in more than one of these categories.

TABLE II.—NUMBER OF STUDENTS IN EACH GRADE AND THE PARTICULAR FINDINGS FOR EACH GRADE AND PERCENTAGES

Grade level	Glasses necessary		Exophoria		Esophoria		Weak ductions		Weak or no binocular vision		Number of pupils
	N	Per cent	*N*	Per cent	*N*	Per cent	*N*	Per cent	*N*	Per cent	
8th...	30	33	33	37	11	12	34	38	11	12	89
7th...	7	30	10	43	4	17	8	35	1	4	23
6th...	8	44	5	28	4	22	8	44	1	5	18
5th...	0	0	1	11	2	22	6	66	0	0	9
4th...	6	40	4	27	1	7	10	66	1	7	15
3rd...	1	16	3	50	0	0	2	33	1	16	6
2nd...	10	36	5	18	5	18	16	57	2	7	28
1st....	8	22	8	22	7	19	16	43	5	13	37

Table II shows the number of students tested in each grade level and the particular findings for each grade. Again the figures represent the frequencies of the conditions specified rather than the classification of the subjects. For example, eighty-nine students from the eighth grade were tested. Among these students an exophoria was found thirty-three times; an esophoria, eleven times; a duction weakness in thirty-four cases and in eleven cases of weak or no binocular vision. Some of these conditions existed concurrently in the same individual. The second column of Table II shows the number of subjects who either needed glasses or needed a change in the glasses they were wearing.

Tables I and II present the results from the eye examinations. Table III shows the results from the reading examinations and establishes their relationship to the eye examinations; also

TABLE III.—DISTRIBUTION OF THE READING SCORES

READING TEST SCORES IN CLASS INTERVALS	NUMBER OF STUDENTS IN EACH CLASS INTERVAL	PERCENTAGE OF STUDENTS WITH EYE SCORES LOWER THAN AVERAGE FOR GROUP
0–49	10	90
50–59	23	74
60–69	39	64
70–79	54	33
80–89	33	16
90–99	21	19
100–109	22	23
110–156	23	17

the distribution based on the reading scores which the school had obtained on our two hundred twenty-five subjects. The reading scores, furnished in terms of grade equivalents, were changed into terms of mental age expectancy. This was necessary in order to control the intelligence factor. Otherwise, for correct appraisal of two students of equal levels of reading retardation, the writers would have to consider the possibility that one may not have the ability to become a good reader, while the other may not be reading up to his mental capabilities. Thus it was attempted to measure reading achievement in terms of what an individual is capable of doing according to his mental ability. Since there was no correlation between reading and eye conditions as measured in our tests, the R being $-.031$, no such control of intelligence in connection with the eye tests was necessary. However, since the problem of correlation will be the subject of a subsequent paper it needs no further discussion here.

According to the above criterion, the lowest reading score obtained by any student was 28, and the highest 156, with an average of 80.24.

In order to discover any relationship existing between poor performance on the reading test and a poor score on the eye

examination the percentage of students who had an eye score worse than the average of the group was calculated. This is recorded in the third column of Table III. For example, of the fifty-four individuals who made reading scores from 70 to 79; thirty-three per cent had eye scores of 6 or higher. The percentage is greatest for the lowest test scores and gradually decreases as the reading scores approach the normal level. Our data show that in children with greater reading abilities, there are fewer with eyes worse than the average, and that, the lower the reading scores, the more likely it is that the child has a peripheral ocular dysfunction. A definite relationship seems to be present, so that in conclusion it may be said that abnormal peripheral ocular variations, such as those considered in this study, are invariably concomitants in direct ratio to abnormal reading skill or efficiency and, as far as the writers can determine now, this relationship seems to be quite constant throughout the various grade levels. Whether the correction or adjustment of these defects would invariably improve reading, is another entirely distinct and important consideration.

SUMMARY

There were two hundred twenty-five students selected at random for whom records of their various achievement tests were available; however, for this study only intelligence and reading scores were used. The students were drawn from the first to the eighth grade.

A fairly complete eye examination was made, including visual acuity, refractive errors, fusion, stereopsis, phorias and ductions. Each eye defect was arbitrarily assigned one point in calculating the scores. Fourteen conditions were considered in the qualitative analysis: poor vision in one eye; poor vision in both eyes; need of glasses or need to change glasses; distant phorias, eso., exo., hyper., regardless of kind or size; near phorias, same as for distant; poor adduction distant; poor abduction distant; poor adduction near; poor abduction near; poor recovery distant adduction; poor recovery distant abduction; poor recovery near adduction; poor recovery near abduction; poor fusion, stereopsis, or no simultaneous binocular vision. The means were calculated for the reading scores and also for the eye condition.

The relationship between reading accomplishments and eye conditions as found by our examinations are discussed in detail.

The conclusion is that definite relationship seems to be present, so that abnormal peripheral ocular variations such as are considered in this study are invariably concomitants in direct ratio to abnormal reading skill or efficiency and are quite constant throughout the various grade levels.

A NOTE ON THE USE OF THE TERM 'OVER-ACHIEVEMENT' IN GUIDANCE AND PERSONNEL WORK*

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The common term employed to describe or explain the discrepancy between tested ability and subsequent scholastic achievement, where the discrepency is in favor of the latter, is the rather ambiguous term 'over-achievement.' Just what a given counselor or educator may mean when he uses this term is difficult to say. The term explains little; it is another example of the too frequent assumption in many psychological fields that to name a thing is to explain it.

A few moment's reflection will, however, lead one to suspect that those who use the term 'over-achievement' probably have one or more of the following referents in mind: first, that the discrepancy between tested ability and achievement, where the latter is higher than the former, is greater than one would predict on the basis of the standard error of estimate. This is a valid statistical interpretation. However, it would seem that it is one of the referents which is relatively rarely used. Second, that the student "really does not have that much ability—he is just 'over-compensating' (often an ambiguous term) for some personality or social inadequacy." The student is considered, and often rightly so, as being a 'grind,' that is, as one who is neglecting all-round personality development because he spends too much of his time on his books. This referent is usually used in a derogatory sense; it is also probably the most frequent meaning associated with the over-achievement concept. A third referent is the feeling that the student is showing a temporary spurt and will soon fall back to his true level of ability and achieve accordingly.

Any or all of these referents, and perhaps others not mentioned, to the over-achievement concept may be correct in any single

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case. They may even be correct more times than they are in error. However, even when a student is really over-achieving there is still little known about his behavior if no attempt is made to go beyond the label itself. It is important to go beyond the label and discover the characteristics of individual over-achievers or any discernable characteristics they may have as a group.

There are several ways in which the over-achievement concept may be in error and, hence, lead to the adoption of less satisfactory ways to guide students who presumably fall into this category. The first error to be considered is the failure to note the nature of the test employed in the prediction of achievement. Elementary principles of measurement state the necessity of using a test standardized on a group similar to the group for which a prediction is to be made. Failure to heed this principle may lead to many kinds of 'wrong' predictions. The statement in a test manual that a given test was standardized on such-and-such a size group of, say, college freshmen tells little. There are many levels of ability represented when one moves from one college to another.[7] When predictions from any given academic ability or intelligence test are to be made, they should be made from a specific test which has for its standardization and norm groups populations similar to the population for which a prediction is to be made. The more specific the prediction the more likely it is to be valid. For example, Segel[4] points out that achievement tests in specific subjects have greater predictive value for individual college subjects than general scholastic aptitude tests, and that a combination of such tests will predict general college achievement better than one scholastic aptitude test.

A second error likely to occur in the use of the term 'over-achievement' is based on the size of the correlation between ability or intelligence tests and later achievement. Taken in general, correlations of this nature are typically from +.35 to +.50, with little likelihood of obtaining an r of +.55.[5] By looking at the formula for the coefficient of alienation, $k = 1 - \sqrt{1 - r^2}$, it will be seen readily that the very high correlation of +.55 between ability and achievement gives an estimate only about sixteen per cent better than chance. This is a rather low figure to be made the basis of so many predictions of what students in

general will do, not to mention the extent to which individual cases are sometimes carried. A correlation of +.86 between ability and achievement gives a prediction fifty per cent better than chance. A correlation of +.86 represents an almost impossible zero-order *r* at this time,[5] and is a sizeable correlation for an *R* (multiple correlation) involving three or four variables.[5] In fact, Odell[9] found that multiple correlations involving two or three variables gave little increase over zero-order *r*'s when predicting marks in high-school subjects.

A third source of error in predictions of this nature becomes noticeable when it is realized that the individual student's experiences are occasionally atypical when compared to the standardization and norm groups of the ability test used or to the group with which the individual is competing for achievement. This point is related to that mentioned as the first source of error, but has more of an individual reference, whereas the first point pertains more to groups. The ability test in this case simply does not sample the individual's abilities; consequently any prediction of achievement is likely to fall short of what is actually accomplished.

Fourthly, the curricular group with which an individual is competing may be a less select group, academically, and hence give rise to the individual's apparent over-achievement when compared to all individuals from whom an ability test measure was obtained. The problem met here is partly one of direct *vs.* differential prediction.[10,11,12,13,14] For example, suppose an individual ranks at the mean of all entering freshmen in a given college. This individual may be enrolled in a curriculum within the college which selects academically less able students, and of these he may be one of the best and receive relatively high grades as a result. Such grades, taken *per se*, would give the appearance of over-achievement; actually the individual in question may be working at slightly above or slightly below his ability level compared with the total population to which the test was given. This type of error makes it clear why a prediction must be made in terms of specific curricular offerings and not for school work in general. Another significant factor here is that the individual, finding himself superior to a large percentage of his competitors, may thus feel motivated to achieve grades even more discrepant than his ability test would seem to indicate.

The fifth error concerns the fact that the usual low reliability of teachers' grades may give rise to a more or less fortuitous confluence of high grades over a period of time, and hence increase the over-achievement ratio. (The same factor of low reliability of teachers' grades may, however, operate in the reverse direction.) This seems to imply that a given student will "get back to his own level sooner or later." However, this factor may operate for a substantial period of time, especially when it is known that (pleasant) personality factors may perpetuate and/or accentuate a spurious relationship between ability and achievement.

The sixth error comes from the fact that the group variability in both the matters of tested ability and the urge to achieve (motivation) may increase the apparent over-achievement of an individual. That is, if group variability on an ability test is very restricted the correlation with subsequent achievement is going to be reduced thereby, which, in turn, increases k and gives room for greater ability-achievement discrepancies to occur. It is likely that the prediction of college achievement is lower than prediction for high-school achievement partly for this reason. Further, if the group variability in terms of the desire to achieve (motivation) is wide, any individual standing near the top in his desire to achieve may show a relatively large ability-achievement discrepancy, especially if his ability score is only average.

Seventh, the heterogeneity of grading standards among teachers is a fact that is often overlooked. It is commonly known that students soon find out which teachers are 'easy,' and that to take more courses from such instructors means more high marks. Reliance on such conditions, especially if they exist in one's major field, can give a fairly consistent appearance of relatively high achievement. The existence of such a condition frees an individual from spending time on one or two such courses and allows him to spend proportionately greater amounts of time on other courses, thereby creating an opportunity for him to increase his whole achievement record.

The eighth error, which has only been implied so far, is motivation. Usually, regression equations do not take motivation directly into account despite the fact that motivation is an important factor. The term motivation almost becomes a shield

for ignorance. Generally, the study of motivation is a leaving-off place in the study of scholastic achievement—and perhaps other topics as well—when it might well be considered a starting place. However, motivation has not been entirely neglected. For example, Crawford[4] found that by studying the 'fixity of life purposes' he was able to change predictive correlations. Studies on the 'level of aspiration' may, in a sense, be considered as studies of motivation.

A condition bound up with motivation is that of systematic study habits. Few individuals work near the top level of their ability for any appreciable length of time or for more than one or two tasks at a time. High motivation, plus efficient work and study habits, can bring a mediocre-scoring individual on an ability test up to where he might very easily be considered superior. Good study habits may permit an individual to show up best over a long period of time whereas limited time allotments, as are offered by most ability tests, put such individuals at a disadvantage and help contribute to ability-achievement discrepencies.

The ninth error lies in the tendency to stretch predictions over too long a period of time. As a result of state-wide testing programs for high-school students, predictions are sometimes carelessly made which are based on test results obtained during the first year or two of high school. These measures are sometimes expected to be reliable measures of what will happen to students academically four to six years later. Predictions of such a nature are not worthless, to be sure, but results like those of Anderson and Spencer[1] and Miner[8] indicate that the value of a predictive item diminishes with successive semesters or years in school. One remedy here is to use cumulative records. The work of Blair[3] and Keys[6] substantiates this point.

The tenth error has been pointed out by Bellows: that "indices of alleged validity predictions are often contaminated by illicit use of predictor factors."[2] An example is the instructor's knowledge of percentile or other ranks of students on psychological examinations and the influence this information has on the grades given students. This factor would operate to give a spuriously high correlation between grades and tested achievement. If these grades were later used as part of the validation material of new tests, the results to new populations examined

on such a test would be vitiated thereby and the subsequent predictions made less valuable.

The eleventh source of error likely to occur in predicting achievement from ability measures lies in the tacit assumption that a test somehow holds priority over achievement as an index of ability. This is a justifiable assumption in many cases, but it may often have notable exceptions. The priority of tested ability over an index of achievement is valid if the test is a 'good' one and if it is properly used, and if the index of achievement is a 'poor' one covering a very short period of time or involving questionable measures of the performance in question. However, even a 'good' test constitutes a far more limited sample of one's behavior than does an achievement record. It is doubtful if the best of the pencil-and-paper variety of tests can produce as valid and reliable results as an actual achievement record in the field utilizing the ability in question. To win success (where 'success' refers to grades, promotions, etc.) in an occupation or in a school, when the probability of success according to tests was low, is not necessarily a case for over-achievement. It may well be simply a case where the test(s), for one or several reasons, failed to sample adequately the abilities in question. It is perhaps illogical to imply that the test holds priority over the actual school or job achievement record by stating or implying that the individual is an over-achiever.

The question of priority requires an empirical attack, and one that is specific to the problem at hand. An individual who achieved well in a small and 'easy' school in, say, a pre-medical course might not be able to maintain passing grades in an academically more highly selected medical school. Surely a good ability test, carefully used, would hold priority over achievement in this case. In other instances, however, where achievement in a reputable school over a substantial period of time is contrasted with a relatively low ability test score, based on norms from the same reputable school population, achievement would seem to hold priority. These are the kinds of cases that may have been overlooked and have led to confusing talk about over-achievement.

The greatest need seems to be for a systematic long-time study of so-called over-achievers to see what personality and ability factors can be identified among them. They are probably a very

heterogeneous group, differing in the arts college from what they are in the engineering school, and both of these differing from those found in the medical school. We need to know more about how these students work; their study habits; their reading skills; their perseverence and willingness to do extra work; their judgments of their own abilities and chances for success; other subtle factors as yet undefined; and above all in importance their success in the practical, after-school world when a perhaps more valid and reliable measure of their ability is met. Until these and similar checks are made, talk about over-achievement should be recognized as resting on somewhat precarious grounds.

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SIGNIFICANCE OF DIFFERENCES IN PROPORTIONS WITH CONSTANT SAMPLE FREQUENCIES IN EACH PAIR

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I. THE PROBLEM

Whenever ten or more pairs of proportions are to be studied for the purpose of ascertaining, at a pre-determined level of confidence, whether the differences between the proportions are significant, the computational work may be considerably shortened if the data satisfy one requirement.

That requirement is met when the two N's, upon which the proportions in each pair are based, are constant throughout the series of paired proportions.

This situation was the case in a statistical analysis of the *Purdue Opinion Poll for Young People*, which is a continuing study of the attitudes of high-school youth.[1] The problem as it appeared there took the forms: which attitudes of rural youth differ in a statistically significant way from those of urban youth? Which opinions of boys differ from those of girls? Democrats from Republicans? Wealthy from poor? To answer those questions most economically, a shortened systematic method of determining significance was developed.

II. DERIVATION OF THE FORMULAS

The method involves drawing a circle graph and plotting a point for each pair of proportions. If the point lies outside the circle, the difference in that pair is statistically significant. If the point falls inside the circle, the difference is not significant.

To derive the necessary formulas,

let k = the critical ratio based upon the normal curve, *e.g.*, 1.96 for a confidence level of .05;

also, let p_1, N_1 and p_2, N_2 be the respective observed proportions and sample frequencies;

then the condition for significance is $\frac{p_1 - p_2}{\sigma_{p_1 - p_2}} \geqq k,$ (1)

[1] Remmers, H. H.: *The Purdue Opinion Poll for Young People*, Division of Educational Reference, Purdue University, February, 1943.

where $$\sigma_{p_1-p_2} = \sqrt{pq}\sqrt{\frac{1}{N_1}+\frac{1}{N_2}},$$

in which $$p = \frac{N_1p_1 + N_2p_2}{N_1 + N_2} \quad \text{and} \quad q = 1 - p.$$

Using the equality in (1) as the boundary of significance and substituting, one obtains

$$p_1 - p_2 = k\sqrt{\frac{N_1p_1 + N_2p_2}{N_1 + N_2}\left(1 - \frac{N_1p_1 + N_2p_2}{N_1 + N_2}\right)}\sqrt{\frac{1}{N_1}+\frac{1}{N_2}}.$$

Now, for simplicity, call $k\sqrt{\frac{1}{N_1}+\frac{1}{N_2}} = K$, $N_1 + N_2 = N$,

$$p_1 - p_2 = y, \quad \text{and} \quad N_1p_1 + N_2p_2 = x'.$$

Then, by substitution,

$$y = K\sqrt{\frac{x'}{N}\left(1 - \frac{x'}{N}\right)}.$$

Squaring yields,

$$y^2 = K^2\frac{x'}{N}\left(1 - \frac{x'}{N}\right)$$

$$y^2 = K^2\frac{x'}{N} - K^2\frac{x'^2}{N^2}$$

$$y^2 + K^2\frac{x'^2}{N^2} - K^2\frac{x'}{N} = 0$$

$$y^2 + K^2\frac{x'^2}{N^2} - K^2\frac{x'}{N} + K^2\frac{1}{4} = K^2\frac{1}{4}$$

$$y^2 + \left(K\frac{x'}{N} - \frac{K}{2}\right)^2 = \left(\frac{K}{2}\right)^2.$$

Now let $$x = K\frac{x'}{N},$$

then $$y^2 + \left(x - \frac{K}{2}\right)^2 = \left(\frac{K}{2}\right)^2. \qquad (2)$$

The graph of this equation is a circle with its center at $x = \frac{K}{2}$, $y = 0$ and a radius equal to $\frac{K}{2}$.

Now examine

$$x = K\left(\frac{x'}{N}\right) = K\frac{N_1p_1 + N_2p_2}{N_1 + N_2} = \frac{KN_1}{N_1 + N_2}p_1 + \frac{KN_2}{N_1 + N_2}p_2.$$

Let $$c_1 = \frac{KN_1}{N_1 + N_2} \quad \text{and} \quad c_2 = \frac{KN_2}{N_1 + N_2}, \tag{3}$$

then $$x = c_1p_1 + c_2p_2, \tag{4}$$

$$y = p_1 - p_2. \tag{5}$$

III. APPLICATION OF THE METHOD

The procedure is as follows:

(1) Decide what critical ratio is to be used as the test for significance, and call it k. For example, if one wishes to determine significance at the five per cent level of confidence, $k = 1.960$. If at the one per cent level, $k = 2.576$. If at the .27 per cent level, $k = 3$.

(2) Calculate $K = k\sqrt{\frac{1}{N_1} + \frac{1}{N_2}}$.

(3) Draw a semi-circle graph with the center at $x = \frac{K}{2}$, $y = 0$ and a radius of $\frac{K}{2}$.

(4) Obtain c_1 and c_2 by the formulas (3), or using

$$c_1 + c_2 = K.$$

(5) Find $y = |p_1 - p_2|$. (The numerical value of $p_1 - p_2$ is used with a semicircular graph, instead of the algebraic value of $p_1 - p_2$ with a circle.) If $y \geqq \frac{K}{2}$, the difference in proportion is significant no matter what x is. If $y < \frac{K}{2}$ find $x = c_1p_1 + c_2p_2$ and plot the point (x, y). If it lies above the semi-circle, significance is indicated at the level chosen. If it lies within, the difference is not significant.

IV. EXAMPLE

This procedure may be illustrated with data from the *Purdue Opinion Poll.* Each of 2898 Indiana high-school pupils responded by complete agreement, partial agreement, uncertainty, partial

disagreement, or complete disagreement to each of a series of statements. In Table I are the results for 1453 boys and 1445 girls in response to the statement, "Sometimes it is necessary to drink to be a good sport." In order to determine statistically significant differences between the reactions of the boys and of the girls to this and other statements, the steps outlined above were followed.

TABLE I.—RESPONSE OF 2898 HIGH-SCHOOL STUDENTS TO THE STATEMENT "SOMETIMES IT IS NECESSARY TO DRINK TO BE A GOOD SPORT," FROM THE PURDUE OPINION POLL FOR YOUNG PEOPLE

	Raw Totals		Proportions		y		x	Point	Sign. Diff.
	Boys	Girls	Boys (p_1)	Girls (p_2)	$\lvert p_1 - p_2 \rvert$	c_1p_1	$c_1p_1 + c_2p_2$	on Graph	at 1% Level
Complete disagreement...	1040	1151	.716	.797	.081				✓
Partial disagreement...	119	94	.082	.065	.017	.0039	.0070	B	
Uncertainty...	61	36	.042	.025	.017	.0020	.0032	C	✓
Partial agreement.....	131	109	.090	.075	.015	.0043	.0079	D	
Complete agreement.....	102	55	.070	.038	.032	.0034	.0052	E	✓
Totals.....	1453	1445	1.000	1.000					

(1) It was decided to check significance at the one per cent level, and k was therefore 2.576.

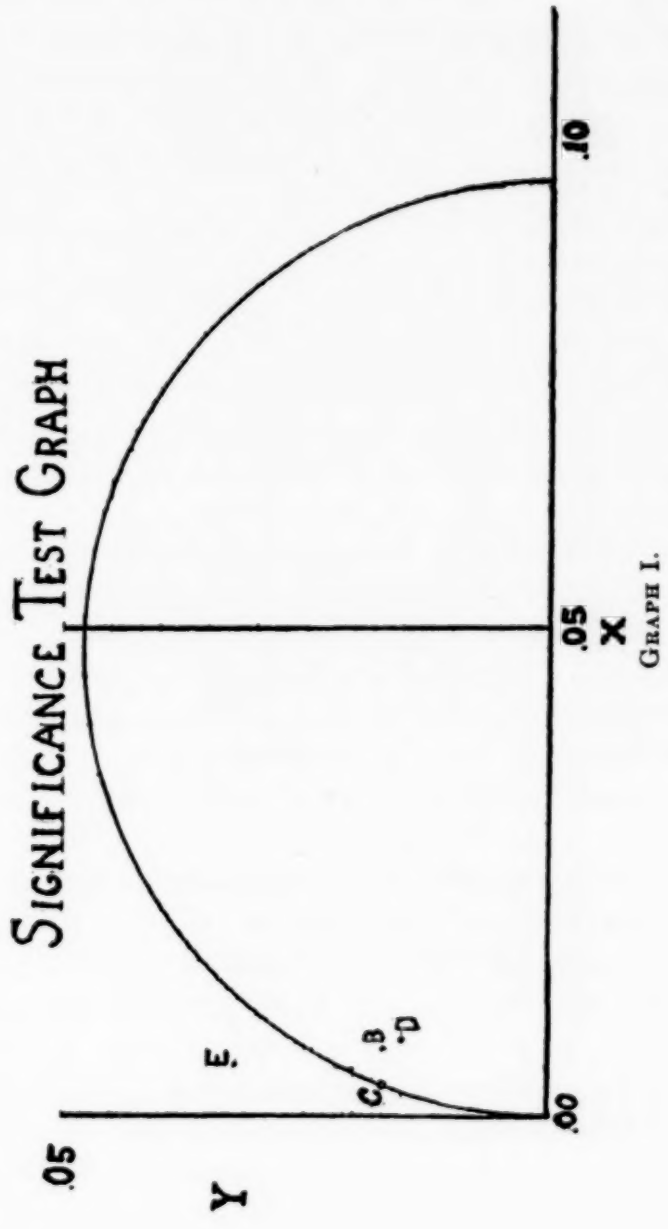
(2) $K = 2.576 \sqrt{1/1453 + 1/1445}$
$= 2.576 \times .03715$
$= .09570$
$\frac{K}{2} = .04785$

(3) See Graph.

(4) $c_1 = .09570^{1453}/_{2898}$
$= .0480$
$c_2 = .09570^{1445}/_{2898}$
$= .0477$

(5) The y's were determined. Wherever $y = \lvert p_1 - p_2 \rvert \geqq .04785$, significance of difference is indicated. For the proportions in

which $y < .04785$, one determines $c_1p_1 + c_2p_2$. When using a calculator, c_1 may be locked in the machine and all c_1p_1's determined first. Then the c_2p_2's are obtained and added mentally to their respective c_1p_1's.



GRAPH I.

The same $\frac{K}{2}$, c_1, c_2 and graph were used for all the other twenty-four statements in the Poll, since the number of boys and girls is the same throughout. Hence one hundred twenty-five cases were readily handled by these same tools.

V. ASSUMPTIONS

It may be well to emphasize the assumptions made in any use of $\frac{|p_1 - p_2|}{\sigma_{p_1 - p_2}} \geq k$. The p_1 and p_2 are to be observed proportions of two samples chosen at random from a population with constant probability p. (This assumption is fairly well fulfilled in sampling from a finite population provided it is large.) In calculating $\sigma_{p_1 - p_2}$ it must be assumed that p is reasonably well approximated by $\frac{N_1 p_1 + N_2 p_2}{N_1 + N_2}$. Finally, we may state a convenient empirical rule of E. S. Pearson[1] for justifying the use of the normal curve critical ratio k. The use is satisfactory if $N_1 p$ and $N_2 p$ both exceed 5, or, if this fails to be true, if

$$\frac{1 - 4pq}{pq} \times \frac{(N_1 - N_2)^2}{N_1 N_2 (N_1 + N_2)} < .04$$

It is also well to note that even where there actually is no significant difference between any of the pairs of p's, some will be apparently "significantly different" by chance factors alone in series of tests. For example, if the level of confidence adopted is five per cent, then chance alone would account for five "significant differences" in one hundred trials, or even seven or eight. To have significance, we should be able to show one of two things:

(*a*) that conspicuously more than the expected number of "significant differences" has resulted,

(*b*) that a single difference is rather more highly improbable than the minimum level requires.

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[1] Kenney, J. F.: *Mathematics of Statistics, Part Two*, p. 120, New York: D. Van Nostrand, 1939.

DOES THE AMOUNT OF FREE READING INFLUENCE THE STUDENT'S CONTROL OF HIS EYE MOVEMENTS IN READING ORDINARY PRINTED MATTER?

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Teachers may assume that students who do a great deal of free reading have much better control of their eye movements than students who read little or none at all for recreatory and informational purposes. That would be a logical conclusion to make from ordinary observation. But one may wish to ask: is it actually so that wide readers make fewer fixations and regressions per line while reading ordinary printed matter and have a greater recognition span for words than limited readers or students who do little free reading? This is the question with which the present discussion is concerned. Since eye-movement habits are conditioned by the type of material read and the purpose for which one reads, the reader of this article will keep in mind that the purpose of the study is to throw light on the relationship of certain eye-movement measures based on reading a simple paragraph of rather easy historical material and the amount of free reading which students say they do outside of their regularly prescribed assignments.

THE PROCEDURE

The procedure of selecting a sampling of students for the study consisted of having four hundred nineteen freshman students who had enrolled in the engineering classes last September indicate on an information blank the number of hours which they spent weekly in reading outside-of-class assignments.[1] The blanks were distributed through the English classes by the regular instructors and collected at the end of the class period.

A record was then made of the amount of reading which each student reported on the blank; and from this record a sampling of fifty-eight students who were fairly well mixed as regards their ability to learn was selected for further study. In order to verify the amount of time which these fifty-eight students spent on

[1] It is presumed that most of the reading was either for leisure purposes or for general information concerning current events.

out-of-class reading weekly, each one, when reporting later to the Reading Laboratory, was asked to look over his information blank and make any changes he believed were advisable.

The next step consisted in making a distribution of the amount of time which these students spent on out-of-class reading. The curve thus completed was quite regular except for two students who stated that they read more than twenty-eight hours weekly. The median amount of out-of-class reading for the group was eleven hours weekly.

The reading material to be checked was itemized in such manner that the students could easily indicate the particular kind of material which they were in the habit of reading for leisure or for general information. The question asked them was: Approximately how many hours do you read the following materials outside of your regular assignments each week?

The final step in the procedure consisted in photographing the eye movements of the fifty-eight students while reading a paragraph of relatively easy historical material, but not until they had read a preliminary paragraph of similar material. The portable eye-movement camera (ophthalmograph) produced and distributed by the American Optical Company was used. The test cards employed were a combination of our own and those developed by the company. They were fairly representative of the kind of reading material which people generally read for leisure or for ordinary information and were not standardized.

THE RESULTS

Each student's reading graph was analyzed for the number of fixations and regressions which he made per line of print; the duration of these fixations and regressions; and the size of the recognition span. These measures and the rate of reading were correlated with the amount of time which the students devoted to out-of-class reading weekly. Table I gives the several correlations.

A glance at the table reveals low correlations between the several measures of eye movements for reading easy historical material and the average amount of reading which freshman college students do out of class. There is not one of the coefficients, save possibly the one of 0.16 between the size of the recognition span and the amount of reading, that is large enough

TABLE I.—THE CORRELATION BETWEEN THE AMOUNT OF READING WHICH FIFTY-EIGHT FRESHMAN COLLEGE STUDENTS DO OUTSIDE OF CLASS AND CERTAIN EYE-MOVEMENT MEASURES AS DETERMINED BY READING ORDINARY HISTORICAL MATERIAL

EYE-MOVEMENT MEASURES	AMOUNT OF READING (WEEKLY)
Rate	.11 ± .130
Fixations	−.09 ± .130
Regressions	−.02 ± .130
Recognition Span	.16 ± .131
Duration of Fixations	.02 ± .130

to indicate the slightest relationship among the several measures correlated.

COMMENTS

The most obvious inference to be made from the limited data of this study is that the students who read a great deal out of class for leisure or for general information did not have better control of their eye movements when tested on a simple paragraph of ordinary reading matter than the students who read little or none at all outside of their regularly prescribed assignments. Recognizing the fact that the central processes exercise considerable control over eye-movement behavior, one may infer from the results of the study that, unless students deliberately attempt to improve their eye movements in reading, they will not likely make much progress in improving the control of their eye movements in reading ordinary printed matter.

Obviously, there are many conditions which must be carefully observed in attempting to analyze a problem of the kind considered in this study. It is generally understood by those who are in a position to know that eye movements are conditioned by the kind of material read and the purpose for which one reads. Then, there is the matter of obtaining adequate measures of the various functions which influence eye movements in reading.

While the group of college freshmen employed in this study was rather small, they did represent a fairly mixed group as regards their ability to learn.

BOOK REVIEWS

Psychology for the Fighting Man. Prepared by a Committee of the National Research Council with the Collaboration of Science Service. Washington, D. C.: The Infantry Journal, 1943, pp. 456. (paper)

This paper-backed handbook with the sub-title, "What You Should Know about Yourself and Others," sells for twenty-five cents and has been prepared by a committee of distinguished collaborators including, G. W. Allport, J. F. Beebe-Center, W. V. Bingham, C. S. Bird, E. G. Boring, R. N. Faulkner, Lt. Col. V. C. Fryklund, Col. Joseph I. Greene, E. R. Guthrie, A. W. Kornhauser, W. R. Miles, H. A. Murray, R. R. Sears, S. A. Stouffer, M. S. Viteles, and Kimball Young. Responsibility for the book in its final form is assumed by E. G. Boring of Harvard University and M. Van de Water of Science Service. As is usual in such cases, the reader is warned against construing the opinions expressed in the manual as being official or reflecting the views of the United States Army or Navy or any of the armed or government services.

What the book amounts to is an attempt to apply the principles and generalizations ordinarily developed in an elementary psychology course to the problems and situations faced by men in the armed services. There are chapters entitled, "Psychology and Combat," "Sight as a Weapon," "Seeing in the Dark," "Color and Camouflage," "Smell—a Sentry," "The Sense of Position," "The Sense of Direction," "How the Army Teaches," "Efficiency in the Army," "Morale," "Food and Sex as Military Problem," "The Soldier's Personal Adjustment," "Leadership," "Mobs and Panic," "Differences among Races and People," "Rumor," and "Psychological Warfare." Some of these chapters were previously published separately in *The Infantry Journal.*

In general the manual is well written. There are some charts and diagrams and a few poorly printed photographs. The style is informal with much use of the second person plural. As is the case with most of the psychology texts directed to men in the armed services, the book is full of admonitions telling the soldier how to do things—how to look through camouflage, how to hear through battle noise, how not to get airsick or seasick,

how to get oriented when lost, how to read rapidly, how to treat fatigue and stop panic and win friends in a foreign country. In many instances the reviewer found the directions a bit less like blueprints than the advertisements implied, but the situations are obviously complex. There is no bibliography nor are there suggestions about laboratory or field experiences other than those included for illustrative purposes in the text.

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ELIZABETH B. HURLOCK. *Child Development.* New York: McGraw-Hill Book Co., 1942, pp. 478.

In contrast to many books in the field, this text attempts to cover the whole period of development from conception to maturity. Various environmental influences are considered without undue stress upon any one. After an historical introduction and a discussion of principles, special sections are devoted to the prenatal period and to the newborn infant. Then follow other chapters on subjects usually considered in texts on child development such as speech, emotions, social behavior, play, religion, and sex. Discussion of personality and learning are scattered through various sections rather than dealing with each in a separate section. An extensive bibliography is included. The general emphasis of the treatise is upon behavior.

Three characteristics are outstanding in this text: (1) The style is clear and concise. (2) The author has done an excellent job in organizing the material into related units for discussion. (3) The literature on the subjects covered is surveyed in a very complete manner with citation of relevant facts. Probably this text excels most treatises on child development in this respect. While all chapters are well done, the ones on motor, social, moral and sex development seem exceptionally good.

The reader will note certain omissions and a lack of emphasis in certain areas: (1) Although the physiological basis of various growth patterns is discussed, it is omitted in the section on emotion. (2) No mention is made of the important group of genetic studies on optical illusions. (3) Eidetic imagery as a genetic factor is not discussed. (4) Some important material on the color vision of children has been omitted. (5) The rôle of rationalization in children's behavior is not adequately stressed.

(6) A section on the development of intelligence with an evaluation of the nature-nurture studies is conspicuous by its absence.

To the reviewer it seems that two general criticisms may be made of the text: (1) There is little critical evaluation of the material and conclusions cited from other writers. Also opinion without support of observations is sometimes given without labeling it as such. (2) At various places in the discussion the author states that guidance is needed to help the child in his adjustment. In several of these instances, no mention is made concerning the kind of guidance that is to be given.

In general, this book may be characterized as a good text. It is easy to read and can be used with profit by both student and instructor.

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GRACE M. FERNALD. *Remedial Techniques in Basic School Subjects.* New York: McGraw-Hill Book Company, 1943, pp. 349.

This book is a contribution of much wider scope than is indicated by the title. It offers a genuine, permanent, and very important addition to the psychology of learning, particularly with regard to pupils having total or partial disability in learning representative school subjects by methods in common use. The validity of the interpretations is vouched for by the results already achieved. All of the substantial number of cases thus far treated, have had their supposed disabilities removed to the point of achievement in approximate correspondence with their general ability as indicated by the mental age of the individual. The analysis of the learning disabilities is adequate, illuminating, and convincing. The techniques by which normal learning is achieved are simply stated and clearly illustrated. It should bring about the discard of much of the current theorizing with regard to 'learning disabilities.'

Moreover the known principles of learning which have long been accepted by the middle-of-the-road psychologist are here applied more adequately, more simply, and to better advantage than in any other similar treatise known to the reviewer. It embodies the results of the work of the author as it has matured in the course of a lifetime of professional service. Its scope is sufficiently broad to include an analysis of the essential aim of

clinical work, of problems of emotional adjustment in learning, and of methods of teaching reading, spelling, and mathematics to pupils of supposed total or partial disability of a specialized sort. Two chapters are devoted to applications to the teaching of the mentally defective.

Incidentally, and without making any such claims, the data presented in this book tend to support in most convincing fashion the validity of the concept of general intelligence, and the approximate identification of it by the best intelligence tests now in use. It turns out that the general ability as indicated by the general intelligence examination, can be utilized provided the basic avenue of approach to the learning available for the individual is not overlooked. It is surprising to find that this is the kinaesthetic sense for so large a percentage of the 'disability' cases. It illustrates once more the fundamental fact that it is difficult for one to understand the nature of a person whose abilities differ in some significant respect from those of ones own. The contribution to the psychology of learning is, as pointed out by Terman in a foreword, strikingly similar to that of Anne Sullivan when she demonstrated the possibility of teaching the deaf and the blind to utilize their mentality, as in the case of Helen Keller. It seems odd that this conquest of 'word blindness' should have been so long delayed.

While the book will be indispensable to those who work with problem children in learning, it should prove to be of almost equal value to the theorist in the psychology of learning, unless his theories are intended for academic purposes only. It will also contribute materially to the understanding and adjustment of many behavior problems.

The book is well organized and as clearly written as the best textbooks on the market. It is far and away superior in these respects to the ordinary book on remedial instruction. It may take some time for it to win its deserved place in the psychology of learning, but that place should be a permanent and an important one.

BENJAMIN R. SIMPSON.

F. O. TRIGGS. *Improve Your Reading.* (A Manual of Remedial Reading Exercises.) Minneapolis: The University of Minnesota Press, 1942, pp. 127.

Several surveys have shown the need for corrective and developmental programs in colleges and universities. Already,

a number of schools have inaugurated courses in which corrective work is offered in a regular systematic sequence. In such a course Triggs' *Improve Your Reading* will be an invaluable aid. It will also be welcomed by the student who plans independently to help himself. It covers in a most effective, direct manner the important habits and attitudes involved in reading various types of materials and is so designed that it is largely "self-sufficient."

The book contains assignments for five weeks' work grouped under the following headings: (*a*) What is good reading?; (*b*) Streamline your reading; (*c*) Get acquainted with strange words; (*d*) To understand what you read; and (*e*) Think as you read.

This volume appears to be the most ingeniously developed and conceived of all books designed to help the college student improve his reading. The exercises are timely and comprehensive; they should prove of great value to many college students who are now seeking an efficient, short method of improving their reading.

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